(3)

HSD-TR-88-001

NOISE AND SONIC BOOM IMPACT TECHNOLOGY

BOOMAP2 Computer Program for Sonic Boom Research: Program Users/Computer Operations Manual

Volume II of III Volumes

Philip J. Day
Thomas M. Reilly
Har y Seidman

BBN Laboratories, Incorporated
21120 Vanowen Street
Canoga Park, CA 91303

August 1988

Final Report for Period July 1986 - November 1987

Noise and Sonic Boom Impact Technology Program
Systems Acquisition Division
Human Systems Division
Brooks Air Force Base, TX 78235-5000

NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government-related procurement, the United States Government incurs no responsibility nor any obligation whatsoever. The fact that the Government may have formulated or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication, or otherwise as in any manner construed, as licensing the holder, or any other person or corporation; or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This report has been reviewed and it is releasable to the National Technical Information Service (NTIS), where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.

Geral L. Long

GERAL L. LONG, LT COL, USAF
NSBIT Program Manager

FOR THE COMMANDER

Michael G. MacNaughton

MICHAEL G. MACNAUGHTON, COL, USAF
Deputy Commander Development & Acquisition

Please do not request copies of this report from the Human Systems Division. Copies may be obtained from DTIC. Address your request for additional copies to:

Defense Technical Information Center
Cameron Station
Alexandria VA 22301-6145

If your address has changed, if you wish to be removed from our mailing list, or if your organization no longer employs the addressee, please notify HSD/SORT, Brooks AFB TX 78235-5000, to help us maintain a current mailing list.

Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION: Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY: N/A	3. DISTRIBUTION/AVAILABILITY OF REPORT: Approved for public release; distribution is unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S): Project 04464, Report 6488, NSBIT TASK ORDER 0001	5. MONITORING ORGANIZATION REPORT NUMBER(S): HSD-TR-88-001, Vol. 2
6a. NAME OF PERFORMING ORGANIZATION: BBN LABORATORIES INCORPORATED; 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION: HSD/YA-NSBIT
6c. ADDRESS (City, State and ZIP Code): 21120 Vanowen Street, Canoga Park, CA 91303	7b. ADDRESS (City, State and ZIP Code): Wright-Patterson AFB, Ohio 45433-6573
8a. NAME OF FUNDING/SPONSORING ORGANIZATION: Noise & Sonic Boom Impact Tech; 8b. OFFICE SYMBOL (If applicable): HSD/YA-NSBIT	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: F33615-86-C-0530
8c. ADDRESS (City, State and ZIP Code): Wright-Patterson AFB, Ohio 45433-6573	10. SOURCE OF FUNDING NOS.: PROGRAM ELEMENT NO. 63723F; PROJECT NO. 3037; TASK NO. 02; WORK UNIT NO. 01
11. TITLE (Include Security Classification): (U) BOOMAP2 Computer Program for Sonic Boom Res. Vol. 2 Prog. Users & Computer Oper. Manual	
12. PERSONAL AUTHOR(S): Day, Phillip J.; Reilly, Thomas M.; Seidman, Harry	
13a. TYPE OF REPORT: Final; 13b. TIME COVERED: FROM 7/86 TO 11/87	14. DATE OF REPORT (Yr., Mo., Day): June, 1988; 15. PAGE COUNT
16. SUPPLEMENTARY NOTATION	

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB. GR.	
20	01		sonic booms
12	05		modelling

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Air Combat Maneuvering Instrumentation/Tactical Air Combat Training Systems (ACMI/TACTS) are used at several Military Operating Areas (MOA) in the United States and abroad as a post-flight pilot debriefing aid in training for air-to-air combat. Engineering flight data are acquired and recorded from several radar facilities simultaneously during flights in appropriately instrumented MOAs. These data are used to generate the information required for subsequent graphical replays of the aircraft position, airspeed, g-value, attitude, climb/dive angle, etc. of the training sortie at post-flight debriefings. The BOOMAP2 and MOAOPS computer programs analyze noise from supersonic aircraft operations by extracting information from a TACTS/ACMI mission standard data tape and compiles a computer library of information concerning the supersonic operations. The BOOMAP2 program utilizes the library produced by the MOAOPS program. The program calculates various statistics on the supersonic operations, and calculates expected sonic boom levels on the ground based on the extracted information. BOOMAP2 can: (1) generate various spatial/temporal distribution

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT: UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION: UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL: Geral L. Long, Lt. Col., USAF	22b. TELEPHONE NUMBER (Include Area Code): (513) 255-8416; 22c. OFFICE SYMBOL: HSD/YA-NSBIT

DD FORM 1473, 83 APR   EDITION OF 1 JAN 73 IS OBSOLETE.

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

19. Continued

statistics; (2) interface with sonic boom generation and propagation models; (3) calculate the intensity and location of sonic booms reaching the ground; and (4) provide the data file used by a commercial graphical software package, GPCP, to plot contours of boom exposure in units of average peak overpressure or C-weighted day-night average sound level (CDNL).

These two programs, when used with an adequate library of aircraft sorties from Military Operating Areas, can be an invaluable tool for environmental planning purposes to predict boom intensity, frequency, and distribution.

This report provides the program user's manual and computer operation's manual for the BOOMAP2 program developed under this contract. The BOOMAP2 program utilizes a sophisticated acoustic ray theory model for predicting the sonic boom overpressures and noise levels on the ground. The model is a modified version of the TRAPS computer program earlier developed by Dr. Albion Taylor. This BOOMAP2 program replaces the earlier BOOM-MAP program which could not provide accurate predictions of the booms resulting from non-steady supersonic aircraft flight.

Keywords: computer models; computer programs; manuals; noise pollution; (KT)

PREFACE

The BOOMAP2 computer program is the result of efforts by several individuals. In particular, the authors of the users manual would like to thank Mr. Dwight Bishop, Ms. Emma Wilby, and Mr. Jerold Haber for their technical assistance.

The support and encouragement of the NSBIT Technical Staff is also gratefully acknowledged, as is the continuing support by Mr. Jerry D. Speakman of the Biodynamics and Bionics Division, Aerospace Medical Research Laboratory, Wright-Patterson AFB.

We also thank Ms. Dorothy Miller and Mr. Kenneth Williams of Tyndall AFB for their aid in helping with the installation of the code on the local Cyber computer.

TABLE OF CONTENTS

LIST OF FIGURES

BOOMAP2 COMPUTER PROGRAM FOR SONIC BOOM RESEARCH: PROGRAM USERS/COMPUTER OPERATIONS MANUAL

1.0 GENERAL

1.1 Purpose

This manual contains the information for both the user and for computer operations. This manual will provide the user's non-ADP personnel with the information necessary to effectively use the system. In addition, it provides the computer operation personnel with a detailed operational description of the system and its associated environment.

1.2 Program History and Overview

The major purpose of the BOOMAP2 and the accompanying MOAOPS programs is to extract and analyze information from the Tactical Air Crew Combat Training System/Air Combat Maneuvering Instrumentation (TACTS/ACMI) system installed at various combat training military operating areas. This information is then used to predict the location and magnitude of sonic boom overpressures on the ground in the vicinity of supersonic flights.

Real time flight information is transmitted to the TACTS/ACMI systems on the ground. Among the data is real time information on aircraft position, velocity and acceleration, updated at intervals of 100 to 200 milliseconds. The MOAOPS program extracts these data for the sonic boom analysis from the tapes at approximately 1.5 second intervals in order to minimize both the time taken to read the tapes and the quantity of information to be stored.

The MOAOPS program is in two parts: a data extraction program EXTRCT, and an index deletion and modification program DELETE. The data extraction program reads the ACMI tapes, extracting relevant information and appending this information to either a new or existing database (library). This library file accumulates the information from all the mission tapes analyzed. The library file is indexed so that a particular mission, aircraft type, etc. can be accessed by the sonic boom analysis programs.

The BOOMAP2 data analysis program accesses the MOAOPS library tapes as selected by the user. The data analysis program produces statistical and graphical output describing the aircraft positions parameters as various measures of predicted boom strength. The BOOMAP2 program produces tabular output of various statistics that is sent directly to a line printer. In addition, for those situations where focused sonic booms are produced, individual plots of the maximum overpressures together with other technical information are produced in the form of a "scratch pad". These "scratch pads" can be plotted for each situation in which focused booms occur.

When a mission is selected from the MOAOPS Library and used as input to the BOOMAP2 computer program, the rays traced by BOOMAP2 are saved in the RAYS Library. If that same mission is then selected at a future time, the necessary ray information is recalled from the library, thus saving substantial computer time.

To produce graphic output, BOOMAP2 creates a file which is compatible with California Computer Products' (CALCOMP) General Purpose Contouring Program (GPCP II) (Reference 1). GPCP II reads this file and generates the necessary plotter directives to produce hard copy graphic output.

The user controls the database subset to be extracted from the MOAOPS Library through the use of an input data file. Through this file, the user specifies: a) the name(s) of the MOA ranges to be considered; b) mission names or dates; c) bounding times of day; d) aircraft types (specific tail numbers optional).

Users also specify the desired output products. These include:

1. A statistical summary of position, speed, and boom strength variables. This summary includes distribution functions of range x-coordinates and y-coordinates, and the aircraft z-coordinate (height above the range), all in feet. It also includes a distribution function of effective height (h_e). Distribution functions of Mach number, cutoff Mach number, and effective Mach number are also presented. Estimated boom strength distribution functions include peak overpressure (in pounds per square foot), the peak overpressure (in dB, re: 20 microPascals), the C-weighted sound exposure level (in dB), and the A-weighted sound exposure level (in dB). The estimated boom strengths are those calculated directly below the extended aircraft flight trajectory using Carlson's Simplified Sonic Boom Prediction Model (Reference 2). Also included are root mean square values for effective height, Mach number, effective Mach number, and cutoff Mach number.

2. A flight track map depicting ground projections of flight paths during supersonic activity.

3. A flight track map depicting ground projections of flight paths during sonic boom producing activity.

4. A noise contour map of average C-weighted sound exposure levels (CSEL).

5. A noise contour map of C-weighted day-night average levels (CLDN). The map requires input of the reference number of daytime operations which is used to convert CSEL to CLDN.

6. A noise contour map of flight-averaged peak over pressures in pounds per square foot, in OASPL or CSEL.

7. A map showing geographic location of maximum overpressures due to focused sonic booms.

The functional relationship between major program elements is shown in Figure 1. Information on executing the MOAOPS program can be found in Reference 3. This manual discusses the execution of the BOOMAP2 program and associated graphics packages. A technical discussion of the algorithms is provided in Reference 4. A maintenance manual is provided in Reference 5.

1.3 Terms and Abbreviations

In this report, overpressure will typically mean the magnitude of the sonic boom at a given point expressed in terms of the maximum overpressure in pounds per square foot (psf) or in terms of the overall sound pressure level (OASPL) in dB, or in terms of the C-weighted sound exposure level (CSEL) in dB. Program options allow a choice of either of these three metrics for the contour presentations.

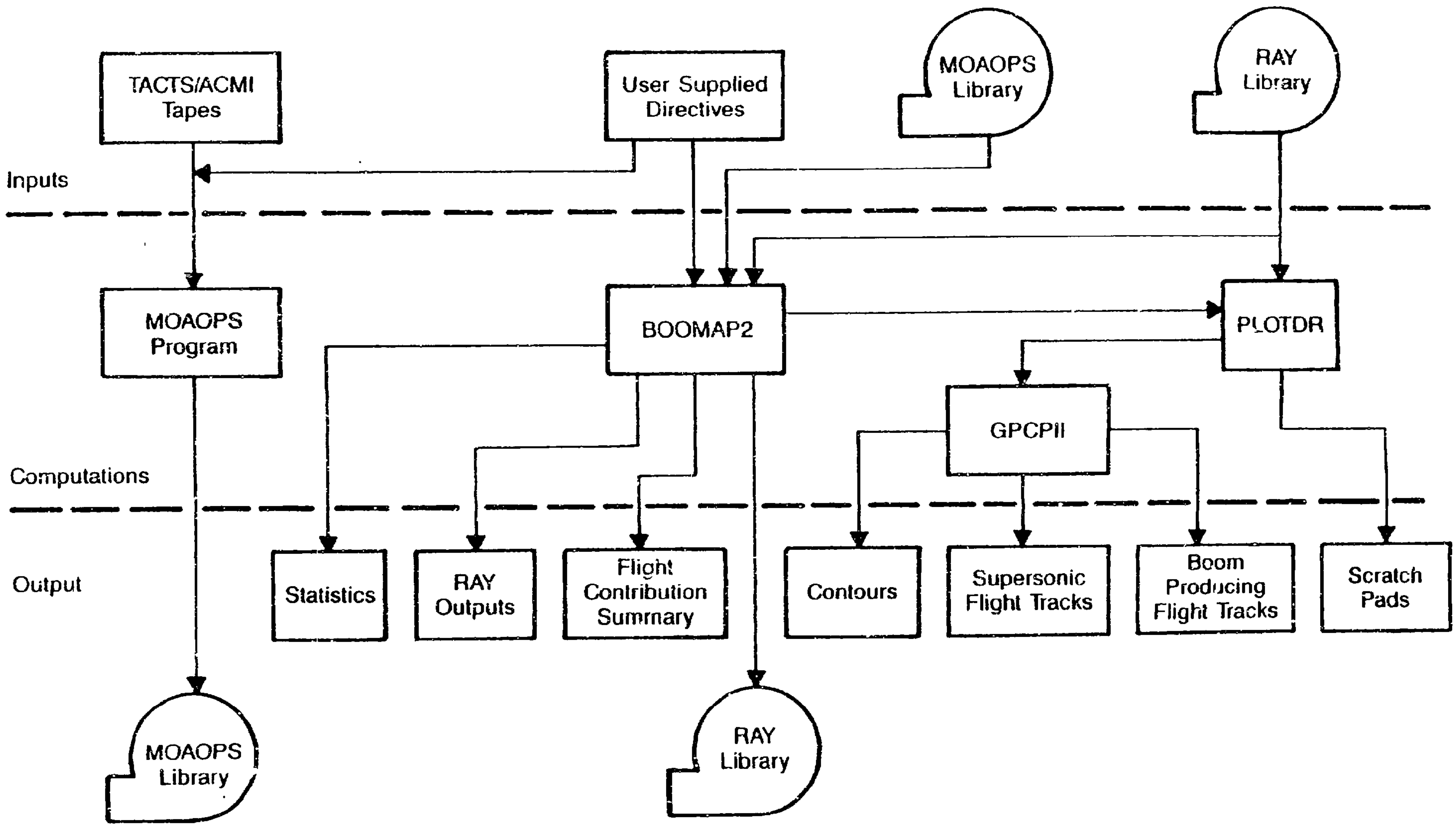


Figure 1. Functional Relationship Between Elements of BOOMAP2 Computer Program

2.0 SYSTEM SUMMARY

2.1 Hardware and Software

The BOOMAP2 software was designed to execute on Control Data Corporation (CDC) computers using the NOS 2.4 operating system. Access to California Computer Products (CALCOMP) General Purpose Contouring Program (GPCP II) is needed to do contour maps and flight-track maps. CDC's UNIPLOT Library is needed to do Scratch Pad Plots. To produce all plots an appropriate pen plotter than can be driven by both GPCP II and UNIPLOT must be attached to the computer systems.

2.2 Resources

The input file consists of several lines of text. The number of lines depends on the complexity of the run but will normally range between five to twenty-five lines.

Two databases are used by the BOOMAP2 program. These are described in more detail in the following section. As installed, the two databases use approximately 1,600,000 words of disk storage. As more operations are included into the databases, these databases will both grow.

The amount of execution time used per run depends upon the number of seconds of supersonic time. Figure 2 shows the number of seconds of central processor time used for typical runs on a Cyber 175. This assumes that this is the first time that these missions have been requested (i.e., the necessary rays have not been previously calculated and stored in the RAYS Library).

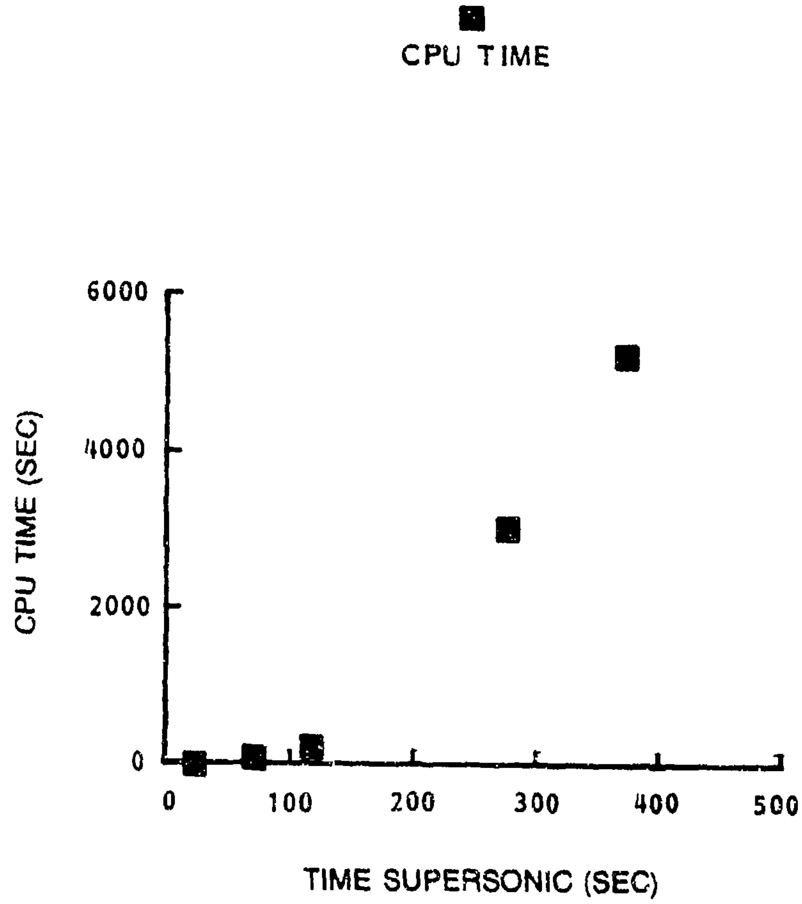


FIGURE 2. COMPUTER TIME USED BY BOOMAP2
WHILE CALCULATING RAYS AND PLOTS.

In both cases contour plots and scratch pad plots were requested. While BOOMAP2 is executing it uses 307,100 octal words of central memory. When the plotting programs are used, the central memory requirement increases to 367,500 octal words.

The output consists of several pages of written information as described later. In addition, the user can request one contour plot, and one flight track map for time above 1.0 Mach and/or for segments during which sonic booms can be expected. The size of these plots is controlled by the user. The number of scratch pad plots depends upon the number of flight segments that produce focused booms. Scratch pad plots are 8-1/2 x 11 inches.

2.3 Databases

Two databases are used by BOOMAP2. The MOAOPS Library is used strictly for input. It contains the necessary information on supersonic flight segments that is needed for calculating the overpressure due to sonic booms. A detailed description of this database is given in Reference 2.

The second database is the RAYS Library. Each time a supersonic flight segment is processed by BOOMAP2, rays are traced that allow for the calculation of overpressures. The calculation of these rays uses significant computer time. Since various flight segments can be added together at will, it is probable that this data will be used again, in a later run. Therefore, it was decided to save the rays into a library to minimize computer time. A detailed description of this RAYS Library is given in the Maintenance Manual (Reference 4).

3.0 PROGRAM EXECUTION REQUIREMENTS

3.1 Job Control Language

Figure 3 shows a sample set of control statements necessary to execute the BOOMAP2 program. The following files are accessed:

1. BMAP2B - relocatable object code for doing ray tracing
2. PLOTDRB - relocatable object code for preparing plots
3. SUBOOM2 - procedure file for running BOOMAP2
4. IFILE - file containing input for BOOMAP2 (Renamed by the procedure)
5. INDEX - direct access file containing index of MOAOPS LIBRARY
6. LIBRY - direct access file containing MOAOPS LIBRY
7. CINDEX - direct access input/output file containing index to RAYS LIBRARY
8. CLIBRY - direct access input/output file containing RAYS LIBRARY.

On output the following files are produced:

1. DFILE - printed output (Renamed by the procedure)
2. FFILE - file containing a printer plot of the GPCP contours (Renamed by the procedure)

```
.PROC,SUBOOM2*I,
IFILE"          INPUT FILE"=(*F),
GFILE"           GPCP FILE"=(*F),
SFILE"   SCRATCH PAD FILE"=(*F),
FFILE"         TAPE15 FILE"=(*F),
DFILE"              DAYFILE"=(*F).
SUBMIT,SBOOM.
.DATA SBOOM
/JOB
PLT2RUN,PO.
/USER
/CHARGE
PURGE,DFILE/NA.
DEFINE,DFILE.
PURGE,FFILE/NA.
DEFINE,FFILE.
GET,IFILE.
ATTACH,BMAP2B/UN=DEMPXTI,M=R,NA.
GET,INDEX=PINDEX/UN=DEMPXTI,NA.
ATTACH,LIBRY=PLIBRY/UN=DEMPXTI,NA.
ATTACH,CINDEX/UN=DEMPXTI,M=W,NA.
ATTACH,CLIBRY/UN=DEMPXTI,M=W,NA.
BMAP2B,IFILE.
REWIND,FIL3.
COPYSBF,FIL3,FFILE.
REWIND,FIL4.
COPYSBF,FIL4,FFILE.
REWIND,TAPE15.
REWIND,RAYDAT.
COPYSBF,RAYDAT,OUTPUT.
RETURN,LGO.
GET,UNIPROC/UN=APPLLIB.
PURGE,SFILE/NA.
DEFINE,NPFILE=SFILE.
BEGIN,UNIPRE,UNIPROC,B=PLOTDR.
PURGE,GFILE/NA.
REWIND,TAPE15.
COPYSBF,TAPE15,FFILE.
GET,GPCP2/UN=APPLLIB.
DEFINE,TAPE9=GFILE.
REWIND,TAPE11.
GPCP2(TAPE11)
REWIND(*)
DAYFILE,DFILE.
REWIND,OUTPUT.
COPYBF,OUTPUT,DFILE,5.
EXIT.
DAYFILE,DFILE.
REWIND,OUTPUT.
COPYBF,OUTPUT,DFILE,5.
/EOF
```

Figure 3. Sample JCL

3. GFILE - file containing GPCP plots (renamed by the procedure)

4. SFILE - file containing scratch pad plots (Renamed by the procedure)

3.2 Input Specifications

This section presents a guide for operating the BOOMAP2 program. The guide describes the input file necessary to control a BOOMAP2 run.

The complete run specification consists of three groups of information. These groups are:

1. A title card which is printed on all output products.

2. Qualifiers used to control the particular flights extracted from the library.

3. Specifiers used to control the particular output products required by the user.

All input file data are free format. That is, data are not restricted to particular columns. Instead, a key word at the beginning of the card specifies the type of data to follow, and parameter values are simply separated by commas in most cases. Space between parameters is ignored and if the parameter list exceeds the 80 columns allowed, the user may continue on the next line without need for any special continuation characters.

3.2.1 TITLE

This line must be the first in the input file. The keyword "TITLE" followed by a space tells the program to accept up to 70 characters for a title. This title will be printed on all output products. The format is:

TITLE (Optional)

FORMAT:

```
TITLE     Title of Run
```

EXAMPLE:

```
TITLE     LUKE AIRFORCE BASE
```

3.2.2 Library Data Qualifier Cards

Access to the information stored in the MOAOPS database library is through the use of qualifier cards. These qualifier cards allow the user to specify criteria for records that are to be included for analysis. The input file may contain from one to five "packets" of qualifiers, where a packet consists of four of the six available qualifier input cards. The input cards are "SITE", "MISSION", "DATE", "TIME", "AIRCRAFT" and "ACWTN". "ACWTN" is the qualifier to call for aircraft with tail numbers. The input must correspond with the following sequence.

"SITE"
"MISSION" or "DATE"
"TIME"
"AIRCRAFT" or "ACWTN"

Each input keyword is followed by one or more parameters separated by a comma or by the word "ALL". The maximum number of parameters allowed is based on the input line. Note that when specific parameters (e.g., missions, aircraft, etc.) are specified they must match exactly the way they are stored in the library index, character for character. In addition, if a sortie qualifies in more than one way with the user input directives it will still be included only once in the analysis.

SITE

The SITE keyword allows the specification of one or more MOA site location names in the input file. The user is allowed a maximum of 20 site location names separated by commas. Site names can occur on more than one line if necessary.

SITE (Required)

FORMAT:

```
SITE      Loc1, Loc2, Loc3, ... Loc20

or

SITE      Loc1, Loc2,
          Loc3, ... Loc20
```

EXAMPLE:

```
SITE      ALL
SITE      LUKE
SITE      LUKE, TYNDALL
```

MISSION or DATE

The keyword "MISSION" allows the specification of one to ten mission names separated by commas. Mission names may occur on more than one line if necessary.

(MISSION or DATE) (Required)

MISSION

FORMAT:

```
MISSION   Name1, Name2, ... Name 10

or

MISSION   Name1, Name2,
          Name3, ... Name 10
```

EXAMPLE:

```
MISSION   ALL
MISSION   5196-18
MISSION   5197-5-DACT, 5196-18
```

The parameter "ALL" is used when all missions are to be included. When the user specifies "MISSION" instead of "DATE" for input, all dates are considered legal. Once "MISSION" is specified in a packet "DATE" is no longer legal.

The keyword "DATE" allows for the specification of one to ten date intervals separated by a comma. Date intervals may occur on more than one line. A date interval consists of a start date followed by a hyphen followed by an end date or simply a start date. All dates must appear in MM/DD/YY format. If only a start date is given, then the end date will be considered identical to the start date.

DATE

FORMAT:

```
DATE      Date1, Date2, ... Date10

or

DATE      Date1, Date2
          Date3, ... Date10
```

EXAMPLE:

```
DATE      ALL
DATE      01/21/85
DATE      01/21/85 - 02/1/85, 4/8/85,
          7/18/86 - 7/19/86
```

The parameter "ALL" may be used when all dates are to be included. When the user specifies "DATE" instead of "MISSION" as input, "MISSION" is no longer legal within that packet.

TIME

The keyword "TIME" allows for the specification of one to ten time intervals separated by commas. Time intervals may occur on more than one line. A time interval consists of a start time followed by a hyphen followed by an end time or simply a start time. All times must appear in HHMM format. If only a start time is given, then the end time will default to 2359.

TIME (Required)

FORMAT:

```
TIME   Time1, Time2, ... Time10

or

TIME   Time1, Time2,
       Time3, ... Time10
```

EXAMPLE:

```
TIME   ALL
TIME   1200
TIME   1100-1200, 1300-1330,
       1400-1500, 1700
```

The parameter "ALL" is used when all time intervals are to be included.

AIRCRAFT or ACWTN

Aircraft may be specified in two ways: by aircraft type alone, or by a specific aircraft type with tail number.

The keyword "AIRCRAFT" allows the specification of one or more aircraft types in the input file. The user is allowed a maximum of ten aircraft types separated by commas. Aircraft types may occur on more than one line. Once "AIRCRAFT" has been specified, "ACWTN" is no longer legal within that packet. The parameter "ALL" may be used when all aircraft types are to be included.

AIRCRAFT

FORMAT:

```
AIRCRAFT  Type1, Type2, ... Type10

or

AIRCRAFT  Type1, Type2,
          Type3, ... Type10
```

EXAMPLE:

```
AIRCRAFT  ALL
AIRCRAFT  F-16
AIRCRAFT  F-15, F-16, F-104
```

The keyword "ACWTN" allows the specification of one or more aircraft types followed by their corresponding tail numbers. The user is allowed a maximum of ten aircraft/tail number pairs separated by commas. Aircraft/tail number pairs may continue on more than one line. A space should be left between the aircraft name and the associated tail number.

ACWTN

FORMAT:

```
ACWTN     AC1 TN1,  AC2 TN2, ... AC10 TN10
```

or

```
ACWTN     AC1 TN1, AC2 TN2,
          AC3 TN3, ...AC10 TN10
```

EXAMPLE:

```
ACWTN     ALL
ACWTN     F-16 LANE
ACWTN     F-15 7163, F-15 131,
          F-16 LANE
```

The parameter "ALL" may be used when all aircraft types and tail numbers are considered legal. Once "ACWTN" has been used, "AIRCRAFT" is no longer considered legal. If the user specified "AIRCRAFT" as input, then all tail numbers are considered legal.

3.2.3 Output Product Specification Cards

The type of output data desired by the user is specified by one or more output specification cards. These cards may be entered in any order.

STATS

This keyword tells the program to print a full statistics summary. This summary includes distribution functions of x, y,

and z position variables, effective height, Mach number, and estimated boom strength (directly below the aircraft). Also included are RMS values of effective height, Mach number, cutoff Mach number, and effective Mach number.

STATS (Optional)

EXAMPLE:

STATS

STATSONLY

This keyword directs the program to set the ray tracing off while still producing a full statistical summary.

STATONLY (Optional)

EXAMPLE:

STATONLY

MACHTRK

This keyword directs the program to generate a flight track map showing those portions of sortie flight tracks where the aircraft Mach number exceeded 1.0. This card contains one numeric parameter which specifies the map scale ratio. For example, to produce a map of one inch equals 10,000 feet, the scale ratio is 120,000.

The smallest scale factor possible is 1:2600 feet, dictated by the numerical input limitations to GPCP. The largest realistic scale factor is 1:45,000 feet, giving a plot approximately 5"x5" in size.

MACHTRK (Optional)

FORMAT:

MACHTRK Map Scale

EXAMPLE:

MACHTRK 120000

BOOMTRK

This keyword directs the program to generate a flight track map showing those portions of sortie flight tracks where sonic booms were generated which propagated to the ground. This line contains the same numeric parameter specifying the map scale ratio as is used with MACHTRK.

BOOMTRK (Optional)

FORMAT:

BOOMTRK Map Scale

EXAMPLE:

BOOMTRK 120000

FFT

The "FFT" keyword allows the user to produce CSEL contour maps using the calculated aged signature (F-Function) values. When this card is used in conjunction with the CSEL parameter on the contour card, the user may no longer use the CLDN or PKOP parameters.

FFT (Optional)

EXAMPLE:

FFT

CONTOUR

The contour keyword is used to direct the program to produce maps depicting contours of equal boom strength. Three different types of contour maps may be specified: (1) CSEL, (2) CLDN, and (3) peak overpressure, in psf. The CONTOUR directives contain a number of parameters which must be entered in a specific order.

CSEL contour maps are specified using the keyword CONTOUR followed by CSEL. Additional parameters must be separated by commas, and must be input in the following order. The first is the scale ratio of the contour map (see MACHTRK or BOOMTRK for a description of the scale ratio). Following the scale ratio, at least one (up to a maximum of 20) CSEL contour values must be specified.

The user may also elect to produce the CSEL contours using the CSEL values stored in the ray library. These values have been calculated using the aged signatures (F-Functions), as

opposed to the program calculating the CSEL values from the stored overpressure values. The user may elect to use the calculated CSEL values using (F-Functions) by selecting the FFT input card. (See FFT card for a description of its use.)

Peak overpressure contour maps are specified using the keyword CONTOUR followed by PKOP. Additional parameters must be separated by commas, and are input in the same order as CSEL contour parameters. The first parameter is the scale ratio of the contour map. Following this parameter must be at least one (up to a maximum of 20) peak overpressure contour value in pounds per square foot. Fractional values are acceptable but the program rounds the user specified values to the nearest tenth of a psf for plotting purposes.

CLDN contour maps are specified using the keyword CONTOUR followed by CLDN. Additional parameters must be separated by commas and must be input in the following order. The first parameter is the map scale ratio. The second parameter is the reference number of daytime operations which will be used on a 10 log(N) basis to convert CSEL values to CLDN. Following these two parameters must be at least one (up to a maximum of 19) CLDN contour value to be plotted.

CONTOUR (Optional, without FFT CARD,
Can Be Repeated Up To 5 Times)

FORMAT:

(1) CSEL Contours:
CONTOUR CSEL, Map Scale, Cntl1, Cntl2, ... Cntl20

(2) PKOP Contours:

CONTOUR PKOP, Map Scale, Cntl1, Cntl2, ... Cntl20

(3) CLDN Contours:

CONTOUR CLDN, Map Scale, Reference Number of Daytime Operations, Cntl1, Cntl2, ... Cntl19

EXAMPLE:

(1) CSEL Contours:

CONTOUR CSEL, 120000, 95, 100, 105

(2) PKOP Contours:

CONTOUR PKOP, 120000, 0.5, 0.8, 1.0, 2.0

(3) CLDN Contours:

CONTOUR CLDN, 120000, 44.5, 55, 60, 65, 70, 75

CONTOUR (Optional with FFT CARD, Can Be Repeated Up To 5 Times)

FORMAT:

CONTOUR CSEL, Map Scale, Cntl1, Cntl2, ... Cntl20

EXAMPLE:

CONTOUR CSEL, 120000, 95, 100, 105, 110

WIDTH

The WIDTH keyword contains a single parameter which tells the plotting software the paper width (in inches) of the plotting

device used for the map output products. If the paper width is too narrow to accommodate the entire map, the plot software will automatically split the map into several panels which can then be assembled to form the full size map. This keyword may appear anywhere among the output product specification keywords or immediately preceding them. The default width is 36 inches.

WIDTH (Optional)

FORMAT: (Default 36 Inches)

WIDTH Plot Width

EXAMPLE:

WIDTH 48

SCRCHPAD

The SCRCHPAD keyword directs the program to produce a crude contour plot of three or less contour levels. A scratch pad plot is produced for each flight segment in each flight track that contains caustic rays. The SCRCHPAD card contains two parameters which must be specified.

The first parameter instructs the program to output the scratch pad plots in either DB or PSF. If DB is selected the contour levels are chosen by the program in intervals of 5 dB (100, 105, 110). If PSF is selected the contour levels are selected in a ratio of 2 to 1, (0.25, 0.5, 1,2 ...).

The second parameter consists of a NEW switch or an ALL switch. If the NEW switch is selected then scratch pad plots are

produced only for the flight segments that have not previously had scratch pads plotted. If the ALL switch is selected then scratch pad plots are produced for all flight segments that contain caustic rays.

SCRCHPAD (Optional)

FORMAT:

```
SCRCHPAD  (DB or PSF)    (NEW or ALL)
```

EXAMPLE:

```
SCRCHPAD  DB   NEW
SCRCHPAD  DB   ALL

SCRCHPAD  PSF  NEW
SCRCHPAD  PSF  ALL
```

3.2.4 Input Example

The following are examples of input data. The first example is a simple case. The second examples shows effective use of the data qualifier keywords.

Example 1: Shown below is the input data file for a relatively simple case:

```
TITLE       NELLIS MOA -- ALL ACTIVITY

SITE        NELLIS
MISSION     ALL
TIME        ALL
AIRCRAFT    ALL

STATS
MACHTRK     96000
```

In this example the title printed on all output is "NELLIS MOA -- ALL ACTIVITY".

The processing software will utilize data only from NELLIS MOA site. It will, however, select all missions, times of day, and aircraft types. For output products, the statistics package will be printed and a map showing flight tracks where aircraft exceeded Mach 1.0 will be plotted to a scale of 1 inch equals 8000 feet.

Example 2: In this example more explicit input qualifiers have been specified.

```
TITLE       HOLLOMAN MOA

SITE        HOLLOMAN
MISSION     5284711-14DA, 5282717-20GI
TIME        0700-2159
AIRCRAFT    F-15  F-4
SITE        HOLLOMAN
```

MISSION	5282723-26RO
TIME	0700-2159
AIRCRAFT	ALL
BOOMTRK	9600
CONTOUR	CSEL 96000, 95, 100, 105
CONTOUR	CLDN 96000, 25.2, 65, 70, 75

In this example the title "HOLLOMAN MOA" will be printed on all output products. In contrast to the first example the program will be fairly selective about the data it extracts from the library. Two packets of data qualifiers are included. Thus the program will select data from the library when either of the two packet conditions are met. It will select data when

a) the site name is HOLLOMAN, the mission numbers are 5284711-14DA or 5282717-20GI, the mission starting time is between 0700 and 2159, and the aircraft type is an F-15 or F-4.

or when

b. the site name is HOLLOMAN, the mission name is 5282723-26RO, and the mission starting time is between 0700 and 2159 for any aircraft sortie meeting these conditions.

The output products will include a flight track map of boom-producing track segments at a scale of 1 inch equals 8000 feet. Two contour maps will be plotted. The first will be a CSEL contour map to a scale of 1 inch equals 8000 feet, containing the 95,100 and 105 dB contours. The second will be a CLDN contour map also plotted to a scale of 1 inch equals 8000 feet. The reference number of daily operations is 25.2 sorties and the desired contours are 65, 70, and 75 dB.

3.3 BOOMAP2 Output

Examples of BOOMAP2 output are shown in Figures 4 to 8. The first output page echoes the input specification cards provided by the user. It also summarizes in table form the library qualifier information which will be used to select specific flight data from the library for processing. The second page echoes the specific flights selected from the database which qualify for processing based on the user supplied input specifications.

The third page contains distribution functions of distance, speed, and overpressure variables for times during which the aircraft Mach number is greater than cutoff. Each distribution function contains a number of histogram cells of specified cell size. The first and last cells are under-range and over-range cells used to collect the tails of the distribution which lie outside the expected range of the particular parameter. The remaining cells are of specific parameter range (identified as cell size in the printout).

For examples, cell number N extend from

Lower bound = [lower band cell 2] + (N-2) [cell size]
to Upper bound = [lower band cell 2] + (N-1) [cell size]

Each cell contains the number of occurrences of the parameter in the cell range at one second intervals. That is, the number contained in cell N is the number of seconds the parameter was observed in the cell range.

SOURCE LISTING:

1: TITLE RUN OF HOLLOMAN
2: SITE HOLLOMAN
3: DATE 10/07/85
4: TIME ALL
5: AIRCRAFT ALL

TABLE: 1/ 1

SITE LOCATION	EXRECISE NAME	DATE [YYMMDD-YYMMDD]	TIME [HHMM-HHMM]	AIRCRAFT TYPE	TAIL NUMBER	#
HOLLOMAN	ALL	[851007-851007]	ALL	ALL	ALL	1

Figure 4. List of Inputs

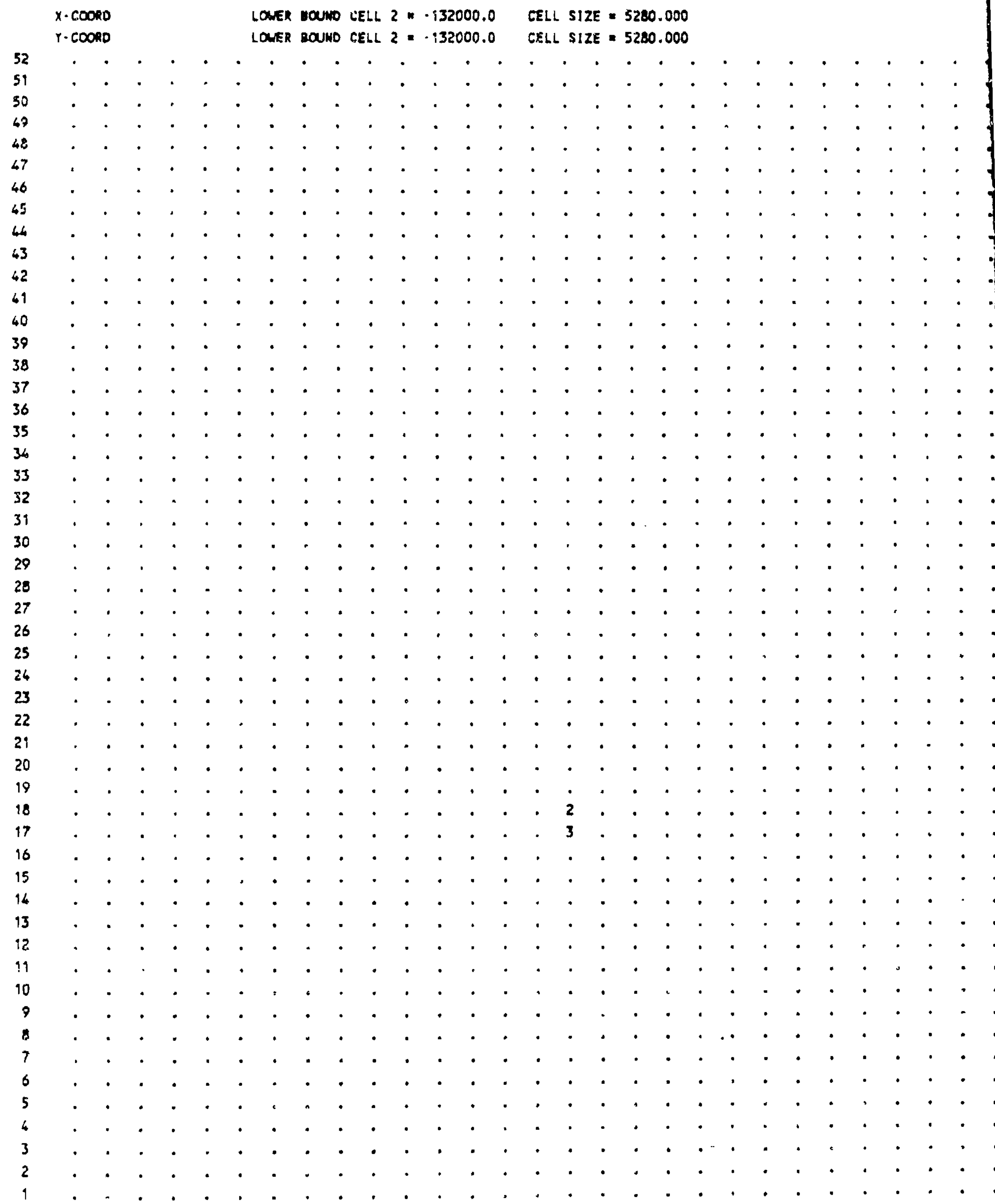


Figure 7. Spatial Distribution

```
      X-COORD          LOWER BOUND CELL 2 = -132000.0    CELL SIZE = 5280.000
      Y-COORD          LOWER BOUND CELL 2 = -132000.0    CELL SIZE = 5280.000
52  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
51  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
50  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
49  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
48  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
47  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
46  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
45  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
44  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
43  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
42  .  .  .  .  .  .  .  .  .  .  .  .  2  .  .  .  .  .  .  .  .  .
41  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
40  .  .  .  .  .  .  .  .  .  1  2  .  .  .  .  .  .  .  .  .  .  .
39  .  .  .  .  .  .  .  .  .  4  .  .  .  .  .  .  .  .  .  .  .  .
38  .  .  .  .  .  .  .  .  2  .  .  .  .  .  .  .  .  .  .  .  .  .
37  .  .  .  .  .  .  .  6  .  .  .  .  .  .  .  .  .  .  .  .  .  .
36  .  .  .  .  .  .  6  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
35  .  .  .  .  .  6  1  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
34  .  .  .  .  2  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
33  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
32  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
31  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
30  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
29  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
28  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
27  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
26  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
25  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
24  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
23  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
22  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
21  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
20  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
19  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
18  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
17  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
16  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
15  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
14  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
13  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
12  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
11  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
10  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 9  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 8  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 7  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 6  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 5  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 4  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 3  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 2  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 1  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
```

Figure 7. Spatial Distribution (Cont.)

5280721-24 10/07/85 7HOLLOMAN F-15 099
ALTITUDE OF THE GROUND IS 4500.00 FT.
FLAG TO XO YO ZO PHIO TG XG YG OP CSEL MACH

5280721-24 10/07/85 7HOLLOMAN F-15 131
ALTITUDE OF THE GROUND IS 4500.00 FT.

FLAG	TO	XO	YO	ZO	PHIO	TG	XG	YG	OP	CSEL	MACH
11	57390.29	24386.	63518.	27858.	-78.000	57483.95	62598.	151892.	.3689	96.2154	1.0291
11	57390.29	24386.	63518.	27858.	-77.000	57478.52	60178.	146415.	.3891	96.7234	1.0291
11	57390.29	24386.	63518.	27858.	-76.000	57474.64	58432.	142504.	.4036	97.1137	1.0291
11	57390.29	24386.	63518.	27858.	-75.000	57471.54	57024.	139379.	.4149	97.2345	1.0291
11	57390.29	24386.	63518.	27858.	-74.000	57468.93	55826.	136748.	.4244	97.5338	1.0291
11	57390.29	24386.	63518.	27858.	-73.000	57466.67	54774.	134463.	.4327	97.6532	1.0291
11	57390.29	24386.	63518.	27858.	-72.000	57464.66	53831.	132437.	.4398	97.9240	1.0291
11	57390.29	24386.	63518.	27858.	-71.000	57462.86	52973.	130615.	.4464	97.8778	1.0291
11	57390.29	24386.	63518.	27858.	-70.000	57461.22	52184.	128959.	.4522	97.9813	1.0291
11	57390.29	24386.	63518.	27858.	-69.000	57459.71	51451.	127440.	.4575	98.1058	1.0291
11	57390.29	24386.	63518.	27858.	-68.000	57458.32	50766.	126038.	.4626	98.2737	1.0291
11	57390.29	24386.	63518.	27858.	-67.000	57457.03	50122.	124737.	.4666	98.2706	1.0291
11	57390.29	24386.	63518.	27858.	-66.000	57455.83	49512.	123523.	.4708	98.3812	1.0291
11	57390.29	24386.	63518.	27858.	-65.000	57454.70	48934.	122386.	.4748	98.4449	1.0291
11	57390.29	24386.	63518.	27858.	-64.000	57453.64	48383.	121318.	.4779	98.9137	1.0291
11	57390.29	24386.	63518.	27858.	-63.000	57452.64	47856.	120313.	.4813	98.8822	1.0291
11	57390.29	24386.	63518.	27858.	-62.000	57451.70	47351.	119363.	.4846	98.7941	1.0291
11	57390.29	24386.	63518.	27858.	-61.000	57450.81	46866.	118464.	.4873	99.2844	1.0291
11	57390.29	24386.	63518.	27858.	-60.000	57449.96	46398.	117612.	.4898	98.9151	1.0291
11	57390.29	24386.	63518.	27858.	-59.000	57449.16	45947.	116802.	.4925	99.8403	1.0291
11	57390.29	24386.	63518.	27858.	-58.000	57448.39	45511.	116032.	.4951	98.8070	1.0291
11	57390.29	24386.	63518.	27858.	-57.000	57447.66	45088.	115299.	.4976	98.9823	1.0291
11	57390.29	24386.	63518.	27858.	-56.000	57446.96	44678.	114600.	.4989	98.9932	1.0291
11	57390.29	24386.	63518.	27858.	-55.000	57446.29	44280.	113933.	.5006	98.9002	1.0291
11	57390.29	24386.	63518.	27858.	-54.000	57445.66	43893.	113296.	.5024	99.0877	1.0291
11	57390.29	24386.	63518.	27858.	-53.000	57445.05	43515.	112687.	.5040	98.9712	1.0291
11	57390.29	24386.	63518.	27858.	-52.000	57444.46	43148.	112104.	.5053	98.9387	1.0291
11	57390.29	24386.	63518.	27858.	-51.000	57443.90	42789.	111546.	.5064	99.1243	1.0291
11	57390.29	24386.	63518.	27858.	-50.000	57443.37	42439.	111011.	.5079	99.0799	1.0291
11	57390.29	24386.	63518.	27858.	-49.000	57442.85	42096.	110499.	.5093	99.1088	1.0291
11	57390.29	24386.	63518.	27858.	-48.000	57442.36	41761.	110008.	.5107	99.3027	1.0291
11	57390.29	24386.	63518.	27858.	-47.000	57441.88	41433.	109538.	.5114	99.1534	1.0291
11	57390.29	24386.	63518.	27858.	-46.000	57441.43	41111.	109087.	.5121	99.2478	1.0291
11	57390.29	24386.	63518.	27858.	-45.000	57440.99	40796.	108654.	.5131	99.2680	1.0291
11	57390.29	24386.	63518.	27858.	-44.000	57440.57	40486.	108238.	.5141	99.1907	1.0291
11	57390.29	24386.	63518.	27858.	-43.000	57440.16	40183.	107840.	.5151	99.1910	1.0291
11	57390.29	24386.	63518.	27858.	-42.000	57439.77	39884.	107458.	.5160	99.2181	1.0291
11	57390.29	24386.	63518.	27858.	-41.000	57439.40	39591.	107091.	.5167	99.2170	1.0291
11	57390.29	24386.	63518.	27858.	-40.000	57439.04	39302.	106740.	.5165	99.3826	1.0291
11	57390.29	24386.	63518.	27858.	-39.000	57438.69	39018.	106402.	.5170	99.3525	1.0291
11	57390.29	24386.	63518.	27858.	-38.000	57438.36	38739.	106079.	.5176	99.3295	1.0291
11	57390.29	24386.	63518.	27858.	-37.000	57438.04	38464.	105769.	.5182	99.3235	1.0291
11	57390.29	24386.	63518.	27858.	-36.000	57437.73	38192.	105472.	.5188	99.3412	1.0291
11	57390.29	24386.	63518.	27858.	-35.000	57437.44	37925.	105180.	.5193	99.3763	1.0291
11	57390.29	24386.	63518.	27858.	-34.000	57437.15	37661.	104916.	.5197	99.4626	1.0291
11	57390.29	24386.	63518.	27858.	-33.000	57436.88	37401.	104656.	.5200	99.3609	1.0291
11	57390.29	24386.	63518.	27858.	-32.000	57436.62	37144.	104407.	.5193	99.4663	1.0291

Figure 8. Rays Calculated

The eleven parameters, defined in Appendix A, are:

1. range x-coordinate in feet (range: -132,000 to +132,000 feet)

2. range y-coordinate in feet (range: -132,000 to +132,000 feet)

3. aircraft height above range center altitude in feet (range: 750 to 50750 feet)

4. aircraft effective height, h_e, above range center altitude in feet (range: 0 to 50000 feet)

5. aircraft Mach number (range: 1.00 to 2.14)

6. aircraft cutoff Mach number (range: 1.00 to 2.14)

7. aircraft effective Mach number (range: 1.00 to 2.4)

8. boom strength overpressure under the projected flight path in pounds per square foot (range: 0.00 to 14.25 psf)

9. boom strength overpressure under the projected flight path in dB re: 20 microPascals (range: 115.0 to 153.5 dB)

10. C-weighted sound exposure level under the projected flight path in dB (range: 90.0 to 128.5 dB)

11) A-weighted sound exposure level under the projected flight path in dB (range: 80.0 to 113.5 dB)

The fourth and fifth pages are a combined two-dimensional distribution function of the x/y range coordinates, parameters 1 and 2 on the previous page. This distribution function shows the spatial distribution of aircraft position during boom producing activity. Cells 1 and 52 in both dimensions are the under-range and over-range tails of the distribution. In the x-direction, cells 1 through 30 are shown in the first half of the table; cells 31 through 52 are shown in the second half.

The output listed after the statistical summary is a listing of the rays that will appear in the library, generated by the selected flight tracks. The output consists of twelve columns: type of ray output, time of the aircraft at position x,y,z, the aircraft x,y,z position, phi angle of the ray, ray termination time, x,y location of the rays termination, ray pressure in psf, CSEL value calculated from the aged signature, and the current Mach number.

This information is also entered in the file CLIBRY and its corresponding index file CINDEX, which allows the processed information to be accessed at a later date without recalculation of the data.

Examples of the flight track and contour maps output by GPCP II are shown in Figure 9 to 14. Map annotation in the title block indicates the type of map plotted. Range coordinates are plotted on the left and top of the map, and a cross is plotted at the range center (coordinates x = 0, y = 0). The y-axis points true north, and the latitude and longitude of the range center are given in the title block.

The output in Figures 15 and 16 are examples of scratch pad plots generated by the program. Each scratch pad plot contains

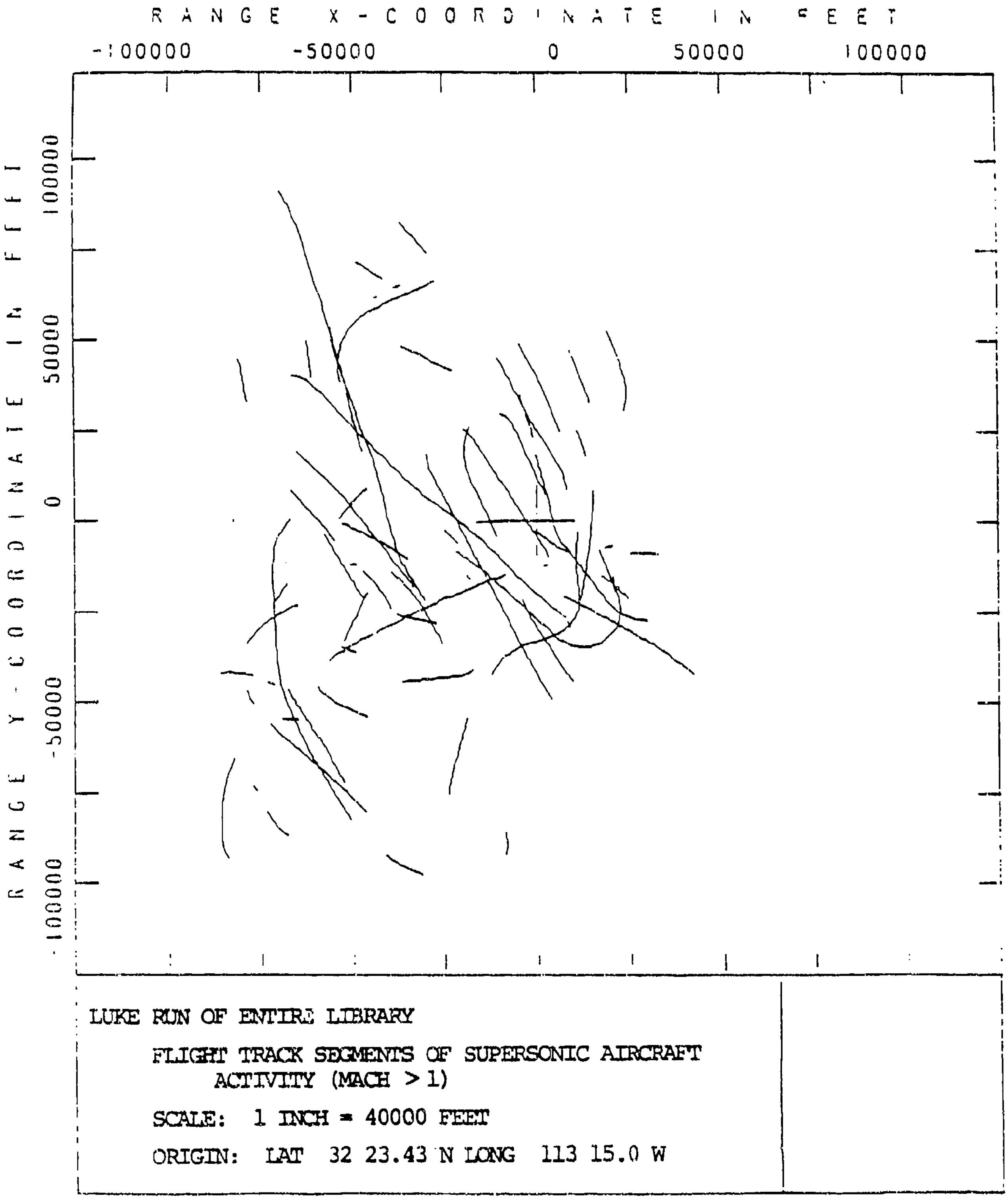


Figure 9. Sample MACHTRK Plot

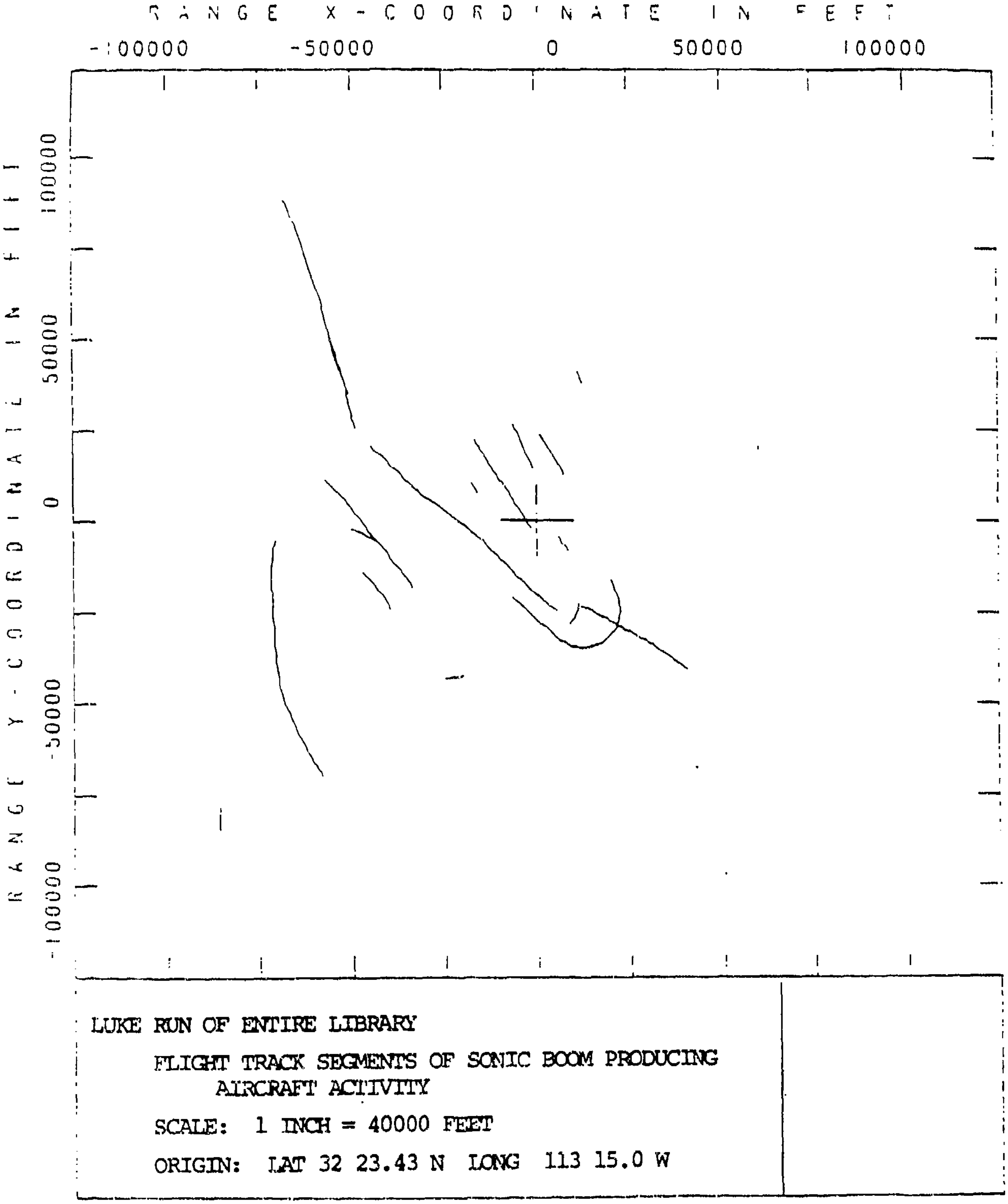
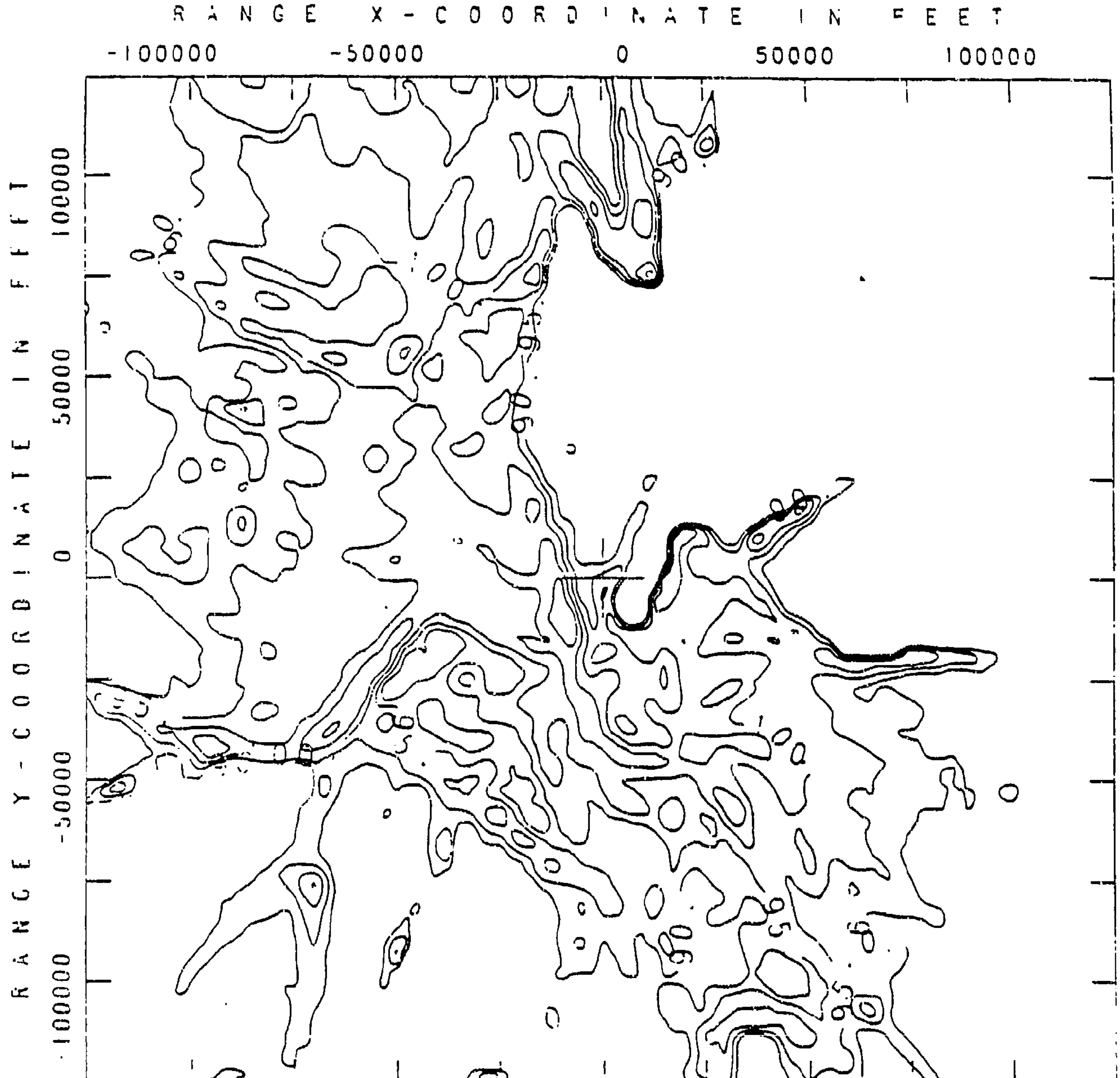


Figure 10. Sample BOOMTRK Plot



LUKE RUN OF ENTIRE LIBRARY

CONTOURS OF AVERAGE C-WEIGHTED SOUND EXPOSURE LEVEL (CSEL), IN DB

SCALE: 1 INCH = 40000 FEET

ORIGIN: LAT 32 23.43 N LONG 113 15.8 W

Figure 11. Sample Contour (CSEL)

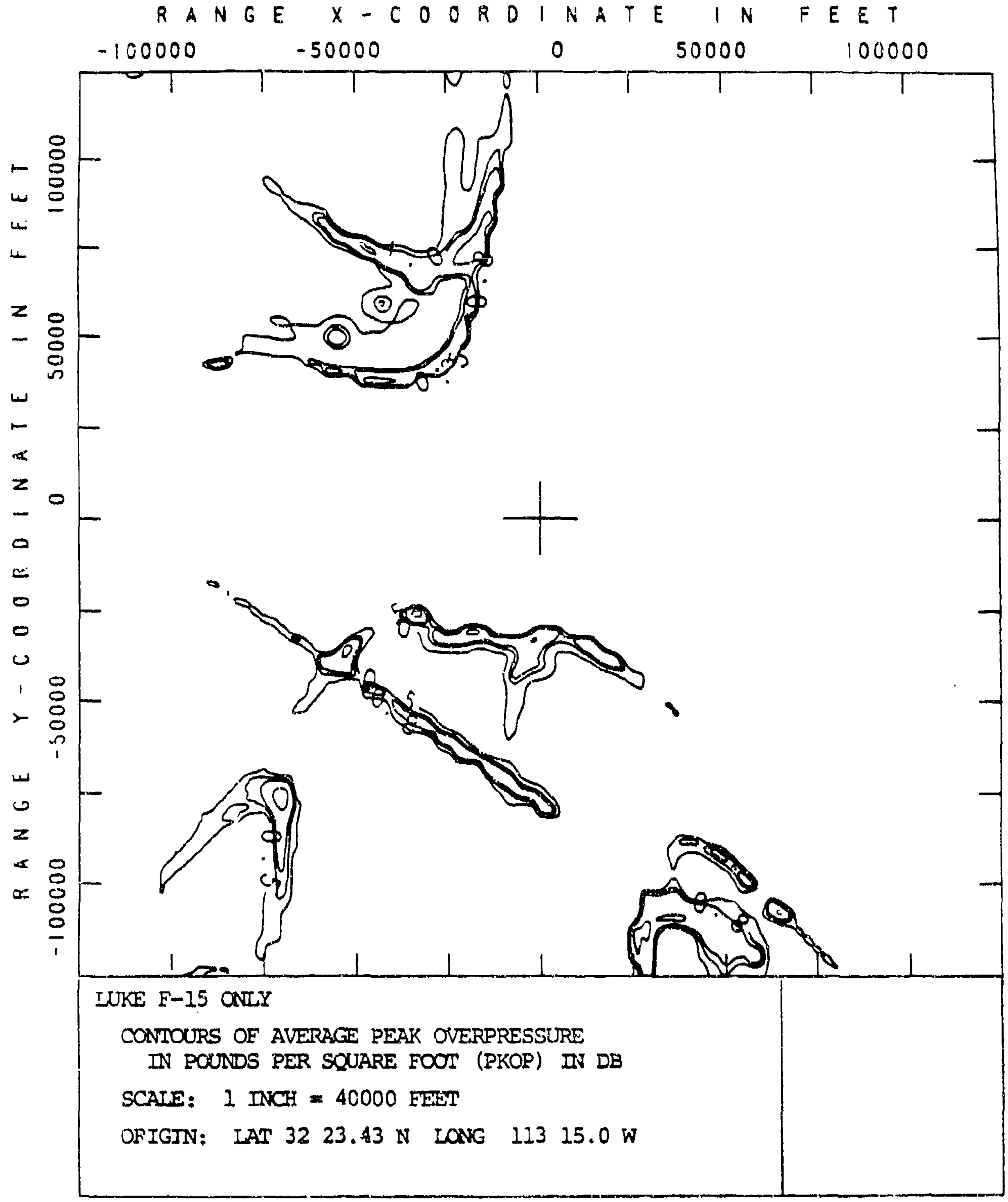


Figure 12. Sample Contour (PKOP)

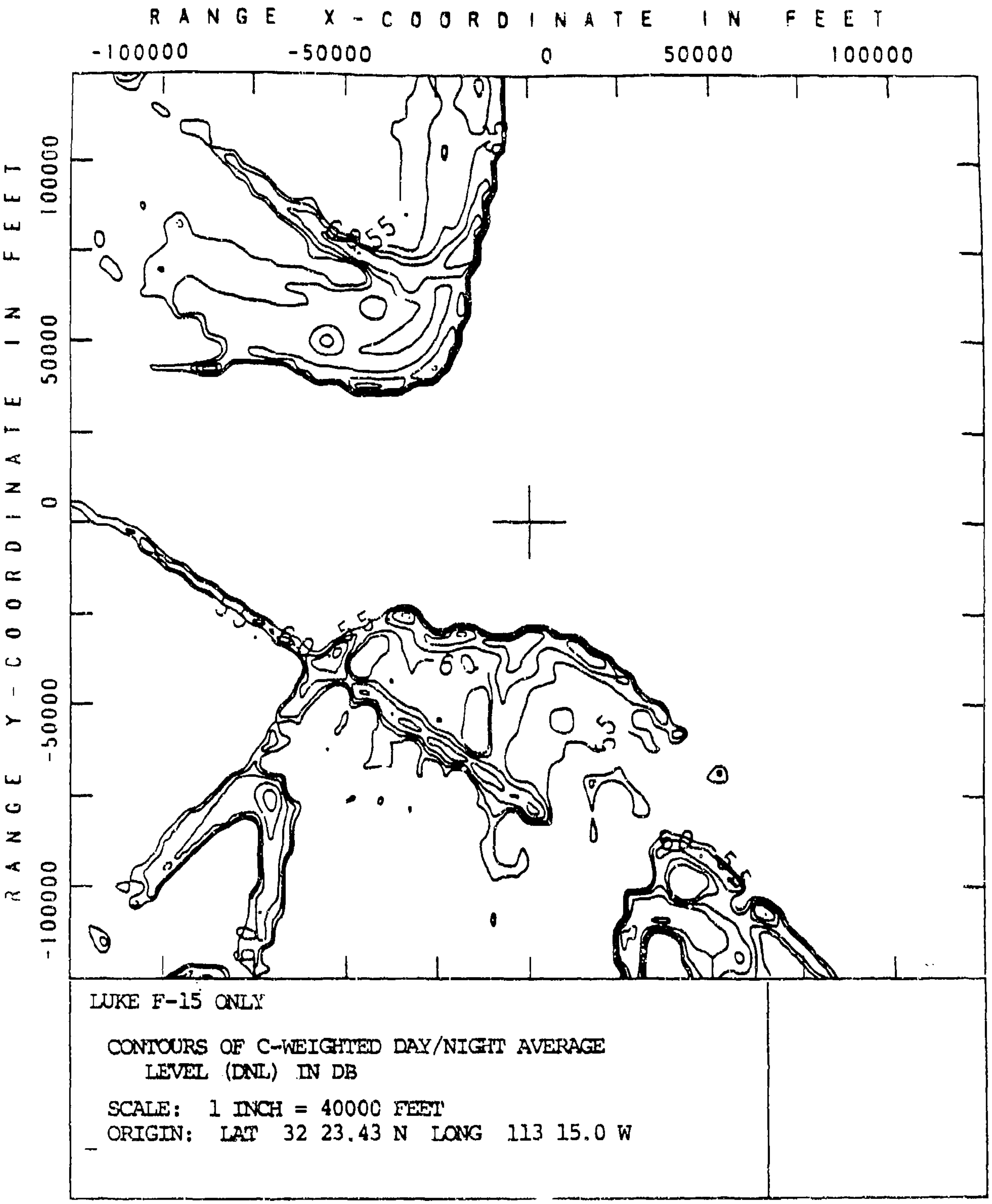


Figure 13. Sample Contour (CLDN)

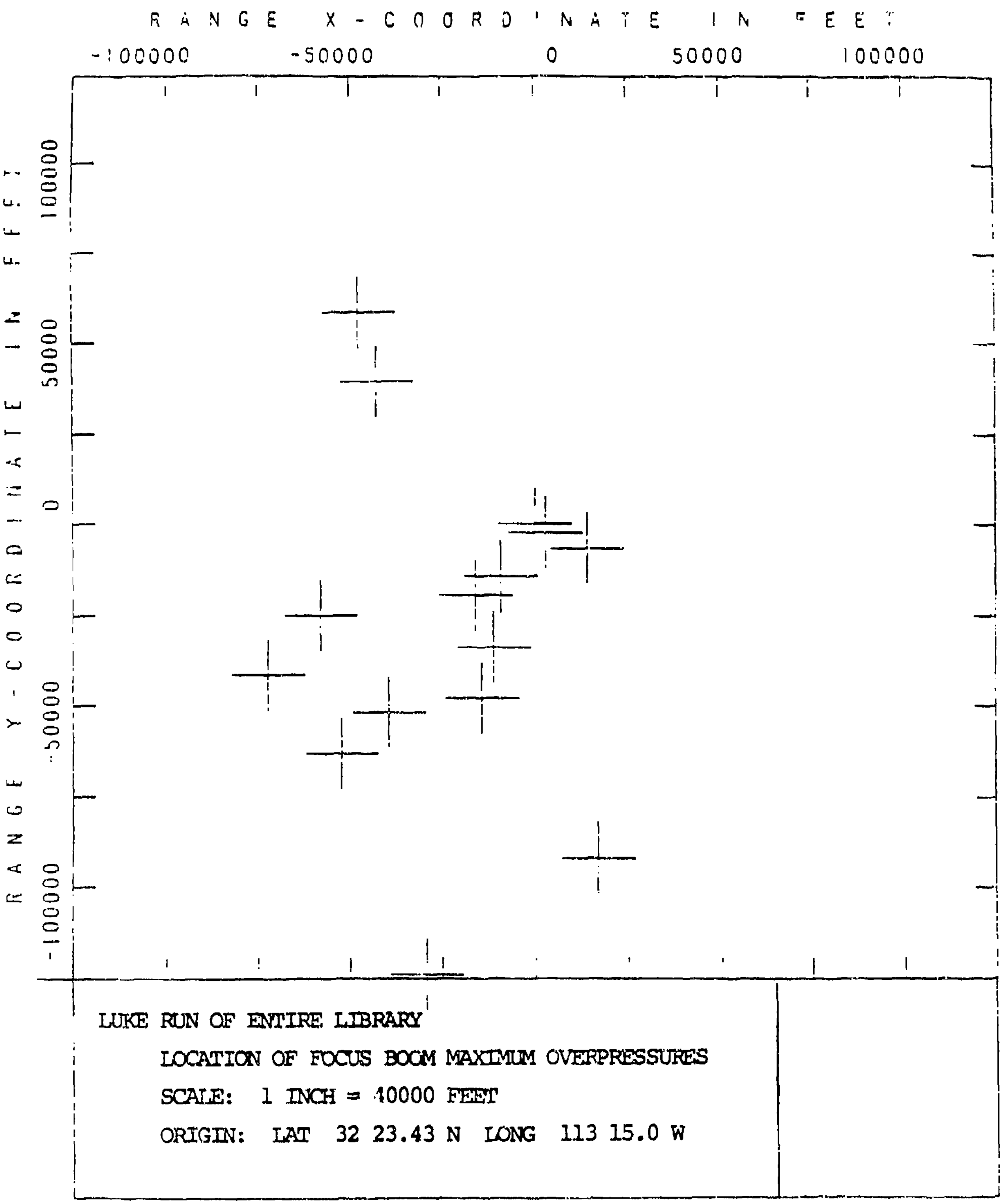
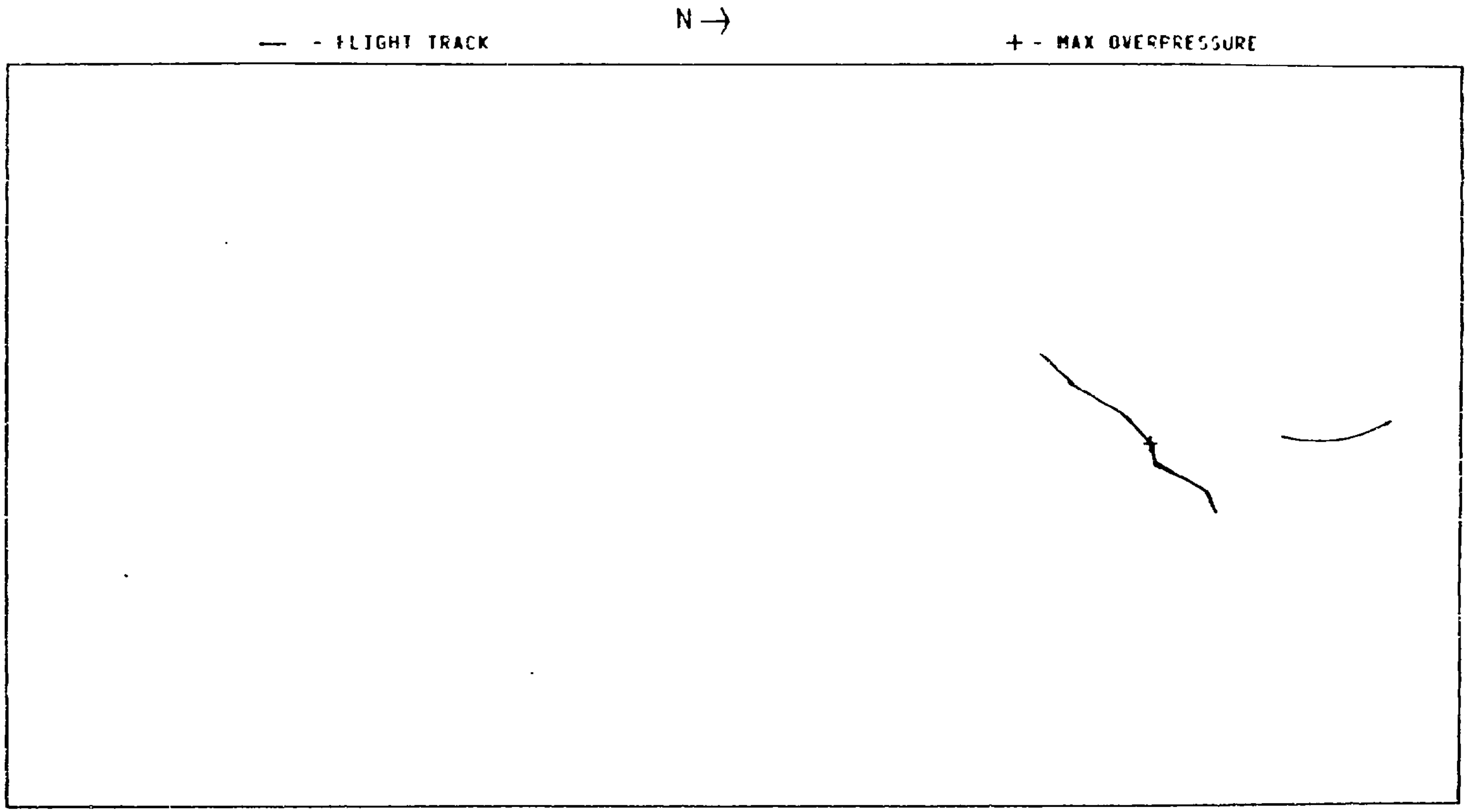


Figure 14. Sample of Peak Overpressure Locations



A/C TYPE	F-15	TAIL #	101
START TIME	12 54 25 39	END TIME	12 54 48 09
START ALT	22 54 K FEET	END ALT	20 16 K FEET
START MACH #	1 0182	END MACH #	1 0861

CARPET BOOM LEVEL	3 04 PSF	RANGE CENTER	
MAXIMUM OVERPRESSURE	9 23 PSF	LAT	33 48 0 N
ENHANCEMENT FACTOR	3 06	LONG	106 25 0 W

AREA OF 147 50 DB CONTOUR LEVEL 0 2570 SQ MILES
AREA OF 145 00 DB CONTOUR LEVEL 2 5600 SQ MILES
AREA OF 142 50 DB CONTOUR LEVEL 5 4464 SQ MILES

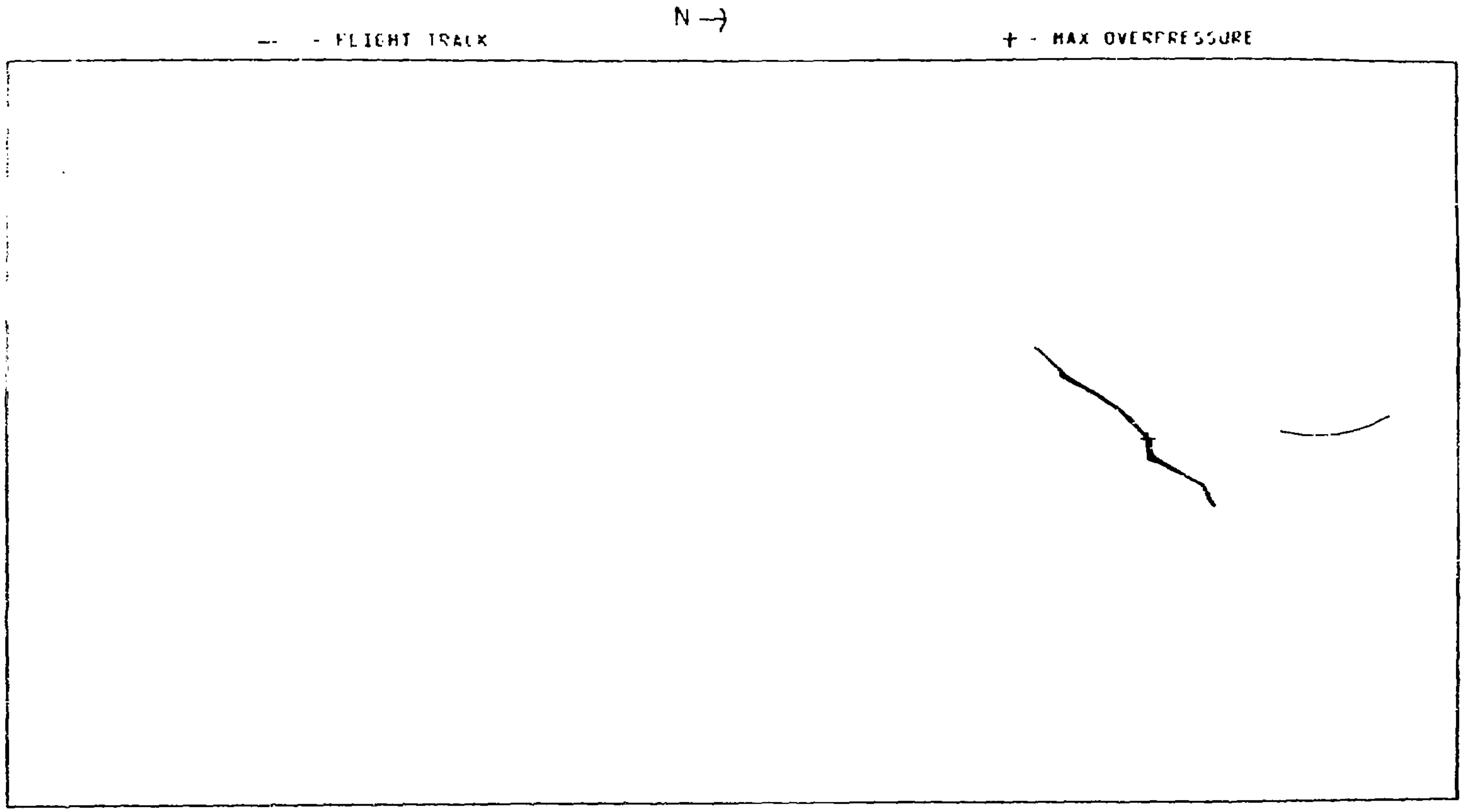
COORDINATES OF MAXIMUM OVERPRESSURE

X COORDINATE	53 59 K FEET
Y COORDINATE	-27 36 K FEET
ALTITUDE	4 50 K FEET

FLIGHT SEGMENT IDENTIFICATION

MISSION NAME	5282717-20GI
MISSION DATE	10/09/85
MISSION SITE	HOLLOMAN

Figure 15. Sample SCRATCH PAD PLOT (dB)



30000 FT

A/C TYPE	F-15	TAIL #	101
START TIME	12 54 25 39	END TIME	12 54 48 80
START ALT	22 54 K FEET	END ALT	20 16 K FEET
START MACH #	1 0102	END MACH #	1 0861
CARPET BOOM LEVEL	3 04 PSF	RANGE CENTER	
MAXIMUM OVERPRESSURE	9 29 PSF	LAT	33 48 0 N
ENHANCEMENT FACTOR	3 06	LONG	106 25 0 W

AREA OF 6 00	PSF CONTOUR LEVEL	2 7672	SQ MILES
AREA OF 6 .0	PSF CONTOUR LEVEL	5 3993	SQ MILES
AREA OF 4 00	PSF CONTOUR LEVEL	6 4721	SQ MILES

COORDINATES OF MAXIMUM OVERPRESSURE

X COORDINATE	53 69	K FEET
Y COORDINATE	-27 36	K FEET
ALTITUDE	4 50	K FEET

FLIGHT SEGMENT IDENTIFICATION

MISSION NAME	5282717-20G1
MISSION DATE	10/09/85
MISSION SITE	HOLLOMAN

Figure 16. Sample SCRATCH PAD Plot (PSF)

the following information: three or less contour levels, a flight track, map annotation, location of the maximum overpressure, aircraft type and tail number, flight segments start and end time, start and end altitudes, start and end Mach numbers, carpet boom level in psf, maximum overpressure in psf, enhancement factor ratio of carpet boom level to maximum overpressure, area of contour in square miles, level of contour in dB or psf, longitude and latitude of range center, x,y,z location of maximum overpressure from range center, mission name, date and site.

REFERENCES

1. GPCP-11, A General Purpose Contouring Program, CALCOMP Applications Software, 1980.

2. Carlson, H.W., "Simplified Sonic-Boom Prediction", NASA Technical Paper 1122, March 1978.

3. Wilby, E., Horonjeff, R., Bishop, D., "User's Guide to MOAOPS and BOOM-MAP Computer Programs for Sonic Boom Research", AMD-TR-86-005, January 1986.

4. Bishop, D.E., Harber, J.M., Wilby, E.G., "BOOMAP2 Computer Program for Sonic Boom Research: Volume 1. Technical Report", BBN Report 6487, August 1987.

5. Day, P.J., Reilly, T.M., Seidman, H., "BOOMAP2 Computer Program for Sonic Boom Research: Volume 3. Program Maintenance Manual", BBN Report 6489, August 1987.